# Model Question Paper-1 with effect from 2019-20 (CBCS Scheme)

USN | | | | | | | | | | |

## Fourth Semester B.E. Degree Examination
## CONCRETE TECHNOLOGY 18CV44

**TIME: 03 Hours** **Max. Marks: 100**

Note: *01. Answer any FIVE full questions, choosing at least ONE question from each MODULE.*
*02. Use of IS:10262-009 is permitted*

| | | Questions | *Bloom's Taxonomy Level | Marks |
|---|---|---|---|---|
| | | **Module -1** | | |
| Q.01 | a | What are the steps taken to reduce carbon footprint of cement? | L2 & CO1 | 05 |
| | b | Discuss about the field tests conducted on cement | L2 & CO1 | 05 |
| | c | Explain the constituents of cement with their percentage and their function? | L2 & CO1 | 10 |
| | | ***OR*** | | |
| Q.02 | a | List out Bogue's compounds and explain their contribution towards gaining of strength of cement. | L2 & CO1 | 08 |
| | b | Explain importance of size, shape and texture of aggregates. | L2 & CO1 | 06 |
| | c | Discuss the importance of use of the following in the manufacture of concrete: *Recycled Aggregates, GGBS, Silica Fume* | L2 & CO1 | 06 |
| | | **Module-2** | | |
| Q.03 | a | What is bulking of sand? Explain the importance of bulking of sand. | L2 & CO2 | 04 |
| | b | Explain the factors affecting workability of fresh concrete | L2 & CO2 | 10 |
| | c | Explain the effects of segregation and bleeding on concrete | L2 & CO2 | 06 |
| | | ***OR*** | | |
| Q.04 | a | Mention the various stages involved in manufacturing of concrete. Discuss any two stages. | L2 & CO2 | 10 |
| | b | Why curing is needed? Explain different methods of curing of concrete. | L2 & CO2 | 10 |
| | | **Module-3** | | |
| Q.05 | a | Define shrinkage and creep of concrete? Discuss about the factors affecting shrinkage of concrete. | L2 & CO3 | 10 |
| | b | Mention Non-destructive tests conducted on hardened concrete. Explain any two of them. | L2 & CO3 | 10 |
| | | ***OR*** | | |
| Q.06 | a | What is durability of concrete? what are the factors affecting durability of concrete | L2 & CO3 | 10 |
| | b | What is maturity of concrete? Explain its significance in gaining the strength of concrete. | L2 & CO3 | 10 |
| | | **Module-4** | | |
| Q.07 | a | Explain significance of concrete mix design and write the steps involved in concrete mix design as per IS code and also discuss the variables in proportioning of concrete | L2 & CO4 | 20 |
| | | ***OR*** | | |
| Q.08 | a | Design a concrete mix for grade M 25<br>a. Grade designation: M 25<br>b. Type of cement: OPC 43 grade | L5 & CO4 | 20 |

| | | | | |
|---|---|---|---|---|
| | | c. Max. nominal size of aggregates 20mm down<br>d. Min cement content: 300kg/$m^3$<br>e. Water cement ratio :0.5<br>f. Workability: 75mm slump<br>g. No chemical admixture<br>h. Fine aggregate: zone II<br>i. Exposure condition: moderate<br>j. Method of concrete placing: manual<br>k. Max cement content :450kg/ $m^3$<br>l. Specific gravity of cement: 3.15<br>m. Specific gravity of coarse aggregate :2.80<br>n. Water absorption of coarse aggregate :1%<br>o. Free surface moisture: nil<br>p. Specific gravity of fine aggregate :2.65<br>q. Water absorption of fine aggregate: 2%<br>r. Free surface moisture: 2% | | |
| | | **Module-5** | | |
| Q.09 | a | Mention the materials used in Self-compacting concrete. State advantages and disadvantages of self-compacting concrete. | L2 & CO5 | 10 |
| | b | Briefly discuss the advantages and disadvantages of Ready-mix concrete | L2 & CO5 | 10 |
| | | ***OR*** | | |
| Q.10 | a | What is light weight concrete? State the advantages of light weight concrete | L2 & CO5 | 10 |
| | b | Explain fibre types used in fibre reinforced concrete | L2 & CO5 | 10 |

# CONCRETE TECHNOLOGY (18CV44) SEM-4th

Q1.a. What are the steps taken to reduce Carbon footprint of cement. (L2 & CO1). MODULE-1

Ans. The total amount of greenhouse gases produced by directly or indirectly support human activities which is expressed in equivalent ton of Carbon dioxide $CO_2$

Steps to be taken

→ The use of waste heat as an alternative source of energy

→ Reduction of clinker to cement ratio

→ The use of alternative and biomass fuel.

→ The use of alternative Raw material

→ An energy efficient Combustion Process.

b. Discuss about the field test conduced on cement. (L2 & CO1)

Ans. 1. Open the bag and take a good look at the Cement. There should not be any visible lumps

2. The colour of the cement should be greenish grey

3. Take a pinch of cement and feel - between the fingers, It should give a smooth and not a gritty feeling.

4. Take a handful of cement and throw it in a Bucket full of Water, the particles should float for some time before they sink.

c. Explain the constituents of cement with their Percentage and their function. (L2 & CO1)

Ans

| | |
|---|---|
| CaO | 60-67 |
| $SiO_2$ | 17-25 |
| $Al_2O_3$ | 3-8 |
| $Fe_2O_3$ | 0.5-6.0 |
| MgO | 0.1-4.0 |
| Alkalies ($K_2O$, $Na_2O$) | 0.4-1.3 |
| $SO_3$ | 1.3-3.0 |

→ Ratio of Percentage to alumina to that of iron oxide - Not less than 0.66

→ Weight of insoluble residue - Not more than 4%

→ Weight of Magnesia - Not less than 6%

→ Total Sulphur content when anhydride ($SO_3$) $C_3A$ is 5% or less, Not more than 3% when $C_3A$ is more than 5%.

→ Total loss on ignition - Not more than 5%.

Q2. a. List out Bogue's Compounds and explain their contribution towards gaining the strength of cement (L2 & CO1)

Ans.

| | |
|---|---|
| Tricalcium silicate | $C_3S$ |
| Dicalcium Silicate | $C_2S$ |
| Tricalcium aluminate | $C_3A$ |
| Tetracalcium aluminoferrite | $C_4AF$ |

→ Tricalcium silicate and Dicalcium silicate are the most important compound responsible for strength Together they contribute 70 to 80% of cement.

→ The average $C_3S$ Content in Modern cement is 45% and that of $C_2S$ is 25%

→ An increase in lime content beyond a certain value makes it difficult to combine with other compounds and free lime will exist in clinker which cause unsoundness in cement.

→ Cements with a high total alumina and high ferric oxide content is favourable to the production of high early strength in cement.

b. Explain importance of Size shape & texture of aggregate ($L_2$ & $CO_1$)

Sol (1) Aggregate Based on Size

Aggregate are classified in two types

Fine Aggregate – Particles are less than 4.75mm

Course Aggregate-Particles greater than 4.75mm

(2) Aggregate Based on shape

→ Rounded aggregate

→ Partly rounded aggregate

→ Angular aggregate

→ Flaky aggregate
→ Elongated aggregates
→ Flaky and elongated aggregates

(3) Aggregates Based on texture.

Surface texture is a measure of the smoothness and roughness of aggregate. As per IS 383-1970 the aggregate are classified in to five groups. namely Glassy Smooth, Granular, Crystalline, Honey Combed and Porous.

C. Discuss the importance of use of the following in the manufacture of concrete ($Cl_2$ & $CO_2$)

Sol. Recycled Aggregate

→ It is produced by crushing Aggregate. Using recycled concrete aggregate (RCA) in new concrete perform equal to Concrete with natural Aggregate.

→ Recycled aggregate produced from all but the poorest quality original concrete can be expected to pass the same test required of conventional aggregate.

→ Higher Porosity of RCA leads to a higher absorption.

## Silicafume

→ It is also called as microsilica or condensed silicafume. It contains 85% $SiO_2$ Content

→ Its influence on fresh concrete :
Water demand in proportion to the amount of microsilicaadded. The increase in water demand of concrete containing microsilica will be about 1% for every 1% of cement substituted.

→ The addition of Microsilica will lead to lower slump but more cohesive mix.

→ large reduction in bleeding and concrete with microsilica could be handled and transported without segregation.

→ Concrete Containing microsilica is vulnerable to plastic shrinkage cracking and therefore sheet or mat curing curing should be considered.

→ Microsilica concrete produce more heat of hydration at the initial stage of hydration. The Total generation of heat will be less that of reference concrete.

## GGBS

GGBS is a nonmetallic product consisting essentially of Silicates and aluminates of Calcium and other Bases.

Its influence on fresh concrete -

→ The replacement of cement with GGBS will reduce the unit weight of water content necessary to obtain the same slump.

→ Reduced heat of hydration

→ Refinement of pore structures

→ Reduced permeability to the external agencies

→ Increased resistance to chemical attack.

## Module-2

Q3. a) What is bulking of Sand? Explain the importance of bulking of Sand. (L2 & CO2)

Sol:- The increase in the volume of sand due to increase in moisture content in known as bulking of sand. A film of water is created around the sand particles which forces the particles to get a side from each other and thus the volume is increased. Sand is used in concrete for reduction of segregation and fill out the pores between cement and coarse aggregate. The Quality of concrete depends a lot on the proper proportioning of the contents. If we do not consider the bulkage of sand, the total quality will be lessened and will impact on the over all concrete quality.

b) Explain the factors affecting Workability of fresh concrete. ($L_2$ & $CO_2$)

Ans Factors —

1) Water content — The higher the water content/ cubic meter of concrete the higher will be fluidity of concrete which is one of the important factor affecting.

2) Mix Proportions — Higher the aggregate cement ratio leaner is the concrete. In lean concrete less quantity of paste is available. In case of rich Mix with lower aggregate/cement ratio, more paste is available to make the Mix cohesive & fatty to give better Workability.

3) Size of Aggregate — For given quantity of Water and paste bigger size of aggregate will give higher workability.

4) Shape of Aggregate — Rounded aggregate or Cubical shaped aggregates are used to have better Workability

5) Surface Texture of Aggregate — Rough textured aggregate will show poor Workability and smooth or glasy textured aggregate will give better Workability

6) Grading of aggregate.
- A well graded aggregate is the one which has least voids to a given with excess amount of paste. The better for the grading the less is the void content and higher workability

7) Use of Admixture - Use of air entraining agents also gives better workability.

C) Explain the effects of Segregation & Bleeding of concrete. (L2 & CO2)

Sol. Effects of Segregation.

→ Problems of leakage, corrosion, carbonation

→ Develops the crack in the concrete
Due to this segregation the strength of concrete is poor in slab or beam or column which cause the development of cracks in the structure

→ lower strength of concrete.
Lack of compaction & Bond formation in concrete due to segregation lower the strength of the concrete.

Effect of Bleeding.

→ Water is pushed upward in bleeding, Sometimes with ~~time~~ this water, specific amount of cement proceeds together with water to the

Concrete Surface

→ If Water is accumulated at the top surface of concrete, the surface finishing is deferred

→ Concrete becomes porous & its Consistancy is affected

→ Excessive bleeding results in rupturing the bond among the reinforcement and concrete

Q4a) Mention the various stages involved in manufacturing of concrete Discuss any two Stages. ($L_2$ & $CO_2$)

Sol. Various Stages.—

1) Batching. 2) Mixing 3) Transposing 4). Placing

5) Compacting 6) Curing 7). finishing.

BATCHING—

It is measurement of Material for making Concrete is known as Batching. There are two Methods of Batching 1) Volume Batching 2) Weigh Batching

Volume Batching is not a good method for proportioning the Material because of the difficulty it offers to measure granular Material in terms of Volume.

Weigh Batching is the correct Method of measuring the Materials for important concrete. Invariably weigh batching System should be adopted.

MIXING —

Mixing of Materials is essential for the production of uniform concrete. The Mixing should be ensure that the mass become homogenous uniform in colour and consistency.

1) Hand Mixing 2) Machine Mixing

Hand Mixing is practiced for small scale unimportant concrete Works As the Mixing cannot be thorough and efficient In Machine Mixing ~~Mixing~~ Mixing of Concrete is almost invariably carried out by Machine for reinforced concrete Work and for Medium or large Scale mass concrete Work. Machine Mixing is not only efficient but also economical.

b) Why Curing is needed? Explain different Methods of curing of concrete. ($L_2$ & $CO_2$)

Sol. In Concrete while hydrating releases high heat of hydration. This heat is harmful

From the point of view of volume stability If the heat generated is removed by some means, the adverse effect due to the generation of heat can be reduced This is done by Curing Process.

Different Methods –

Water Curing – This is the best Method of curing as it satisfies all the requirments of curing namely promotion of hydration, elimination of shrinkage and absorption of heat of Hydration. Water curing can be done by immersion, Ponding, Spraying or Fogging, Wet covering.

Membrane Curing – The quantity of water normally Mixed for making concrete is more than sufficient to hydrate the cement, provided this water is not allowed to go out from the body of concrete For this reason concrete could be covered with membrane which will effectively seal of the evaporation of water from concrete.

Steam Curing – The development of strength of concrete is a function of not only time but also that of temperature. When concrete is subjected to higher temperature it accelerates the hydration process resulting in faster development of strength. Concrete cannot be subjected to dry heat to accelerate the hydration process as the presence of Moisture is also an essential requisite. Therefore subjecting the concrete to higher temperature and maintaing the required Wetness can be achieved by subjecting the concrete to steam curing

Accelerating Curing – The strength of the concrete is determined within 7 hrs of casting and this accelerated strength show good relationship with 7 and 28 days strength of normally cured Concrete. In this test standard cubes are cast, that are covered with top plate and joints are sealed with special grease to prevent drying.

MODULE-3

Q5a. Define Shrinkage and Creep of Concrete?

Discuss about the factors affecting shrinkage of concrete. (L2 & CO3)

Ans Creep is time dependent deformation of concrete under permanent loads PT forces and permanent displacement. The time-dependent strain is termed as creep.

factors —
1) Concrete Mix Proportion 2) Aggregate properties 3) Age of loading 4) Curing Conditions 5) Cement Properties 6) Temperature 7) Stress level.

Shrinkage is shortening of concrete due to drying and is independent of applied loads. It is time dependent strain measure in an unloaded and unrestrained specimen at constant Temperature.

Factors —
1) Drying Condition 2) Time 3) Water-Cement Ratio.

b) Mention Non Destructive tests conducted on hardened concrete Explain any two of them. (L2 & CO3)

Ans 1) Visual Testing
2) Schmidt's Rebound hammer Test

3) Ultrasonic Pulse Velocity Test
4) Penetration Resistance or Windsor Probe Test.

## Rebound Hammer Test

It proride a fairly accurate estmate of concrete compressive strength. The surface of the concrete at the point tested must be smooth, dry and free of honey Combing otherwise rebound greadings would be low indicating a weaker concrete than the actual case. The Readings are taken along the edge of tank on the sides of wall and where the adjoining concrete. (wall, top or bottom)

## Pulse Velocity Method

This is based on the principle that the velocity of an ultrasonic pulse through any Material depends upon the density. High Velocity is obtained when concrete quality is good in terms of density, uniformity etc. It is used to assess the presence of cracks, voids etc. quality of Concrete relative to standard requirement
1) Direct Transmission 2) Indirect 3) Surface
These Techniques are used to measure.

Q6a. What is durability of concrete. What are the factors affecting durability of concrete (L2 & CO3)

Sol. It is defined as the resistance to deterior-ating influence, which may exist inside the concrete itself or which are present in the environment to which the concrete is exposed.

Factors affecting Durability

* External factors physical, chemical or Mechanical.
* Environmental such as extreme temperature abrasion & electrostatic action.
* Attack by natural or Industrial liquid and gases.
* Internal factors - Permeability of concrete, alkali aggregate reaction Volume change due to difference in thermal properties of the aggregate and cement paste.

b) What is Maturity of Concrete. Explain its significance in gaining the strength of concrete (L2 & CO3)

Sol. It is the sum of product of temperature

(above datum level -11°c at which hydration stops) and time over which this temperature occurs.

$$M = \text{Sum}\ (\text{Temperature} \times \text{time}).$$

Significance –

It is an Index value that represents the progression of concrete curing. It is based on an equation that takes into account concrete temperature, time & strength gain. It is an accurate way to determine the real-time strength value of curing concrete. It is useful for estimating the strength of concrete at any other maturity as a percentage of strength of concrete of known Maturity

## MODULE – 4

Q7.a) Explain the significance of concrete Mix Design and write the steps involved in concrete Mix design as IS code and also discuss the variables in proportioning of concrete ($L_2$ & $CO_4$)

Ans. Variables –

1) Water/Cement Ratio
2) Cement Content
3) Relative proportion of fine & Coare aggregate
4) Use of admixture
5) Consistency

## Procedure of concrete Mix Design as per IS 10262

1) Calculation of target strength of concrete
2) Selection of Water Cement Ratio
3) Determination of aggregate air content
4) Selection of Water Content for concrete
5) Selection of Cement Content for concrete
6) Calculation of aggregate Ratio
7) Calculation of aggregate Content for concrete
8) Trial Mixes for testing Concrete Mix design strength.

### Significance –

A good concrete Mix design creates the foundation of a sound infracture. Concrete Mixdesign involves a process of prepara -ation in which a mix of ingredients creates the required strengths and durability for the Concrete Structure. It is required that all the materials needed for concrete should be tested to determine the physical propestiesof such material. The value of the physical propesties obtained will be used for as basis of all the design consideration for the Mix Design.

Q8a) Design a Concrete Mix for grade M 25 Using 10262:2009. ($L_5$ & CO4)

Step1 Determination of Target strength

$f_t = f_{ck} + 1.65 \times S = 25 + 1.65 \times 4 = 31.6 \text{ N/mm}^2$

Step2 Selection of w/c Ratio : Given 0.5

Assuming 0.45

0.45 < 0.55 (Hence provided 0.45)

Max. w/c Ratio for mild exposure = 0.55 from Table I S 456-2000. Table 5 pg 20.

Step.3 Selection of Water ~~Cement~~ Content.

From Table 2 pg.3 Is 10262:2009.

For Angular Size Aggregate for every 25 mm increase in slump - Increase the Water Content by 3%; for Size of Aggregate = 20mm

50mm - 186 kg

75mm ↑ by 3%

100mm ↑ by 3%

6%

$\frac{186 \times 6}{100} + 186 = 197.16$ kg/m³ for 100mm Slump

Step.4 Selection of Cement Content

Cement Content = $\frac{\text{Wc}}{\text{w/c Ratio}} = \frac{197.16}{0.45}$

438.13 kg/m³

For 75mm slump - $\frac{186 \times 3}{100} + 186 = 191.58$ kg/m³

Cement content will be $\frac{191.58}{0.45} = 425 \text{ Kg/m}^3$

Min Cement Content = 300 Kg/m³

425 > 300 Kg/m³

Max. Cement Content = 450 Kg/m³

From Table-5 of IS 456-2000 clause 8.2.4.2

Step.5 Estimation of Coarse Aggregate

From Table 3 of 10262:2009. for 20 mm Size Aggregate for w/c Ratio of 0.45 (Assumed) and Std value 0.5

Zone II (given) for fine aggregate

Volume of Coarse Aggregate Per unit of Volume of Total aggregate = (0.62 + 0.01) = 0.63

Volume of Fine Aggregate 1 − 0.63 = 0.37

Step.6 Mix Proportion.

a) Volume of Concrete 1 m³

b) Volume of Cement = $\frac{425}{3.15} \times \frac{1}{1000} = 0.1349$ m³

c) Volume of Water = $\frac{191.58}{1} \times \frac{1}{1000} = 0.191$ m³

d) Volume of Total aggregate

= a − (b + c) = 1 − (0.1349 + 0.1915)

= 0.6736 m³

e) Mass of Coarse Aggregate

= 0.6736 × 0.63 × 2.8 × 1000 = 1188.23 Kg/m³

f) Mass of fine aggregate

$0.6736 \times 0.37 \times 2.65 \times 1000 = 660.46 \text{ Kg/m}^3$

Mix Proportion.

| Water | Cement | Fine Aggregate | Coarse Aggreg. |
|---|---|---|---|
| 191.58 | 425 | 660.46 | 1188.23 |
| 0.45 | 1 | : 1.55 : | 2.79 |

## MODULE -5

Q9. a) Mention the Materials used in SCC. State advantages and disadvantages of Self Compacting Concrete ($L_2$ & $CO_5$)

Sol: Materials - 1) Cement - OPC 43 or 53 grade

2) Aggregate Max size limited to 20mm and fine aggregate 125 micron are considered as fines.

3) Mixing Water - Portable drinking water

4) Chemical Admixture - Viscosity Modifying Agent (VMA), air entraining Agent (AEA)

5) Mineral Admixture - Flyash, GGBS Silicafume are used.

6) Stone Powder - Finely crushed lime stone, dolomite or granite.

7) Fibres - To enhance the property of SCC various shaped fibres are used.

Advantages and DisAdvantages

Advantage.

1) Fast placement without Mechanical consolidation
2) Improved Construbility.
3) Reduce Permability in concrete Structure
4) Minimize Void in trigh ~~reforced~~ reinforced area.
5) Eliminates Problems associated with concrete Vibration.

Disadvantages

1) More Precise measurement and moinitoring of the constituent materials
2) Costlier than the conventional concrete based on concrete Material cost
3) The cost of SCC is 10-15% higher than the conventional concrete.
4) No specific IS Code for Mix Design.

b. Briefly discuss the advantages and disadvantages of Ready Mix concrete (L2 & CO5)

Sol. Advantages of RMC

1) Better quality of concrete is produced
2) Elimination of Storage space for basic Material at site

3) Wastage of Basic Material is avoided
4) Time required is greatly reduced
5) Labour associated with production of Concrete is eliminated.

## Disadvantage of RMC

1) Need huge initial investment
2) Not affordable for small project
3) Needs effective transportion system from RMC to Site.
4) Traffic Jam or failure of Vehicle creates Problem.
5) Labours should be ready on site to cast the concrete in position. to vibrate it and compact it

Q10) What is light Weight Concrete.? State the advantages of light weight concrete (C2 & CO5)

Ans Defination — It is a Special concrete which weighs ligher than conventional concrete Density of concrete is low (300 to 1850 kg/m³) When compared to Normal Concrete.

## Advantages of light Weight Concrete

1) Reduce the dead load of the building
2) Easy to handle and hence reduce the cost of transportation and handling
3) Improve the Workability
4) Relatively low thermal conductivity
5) Rapid and relatively simple Construction.
6) Helps in disposal of industrial Waste like flyash, clinker, slag etc.

Q.06 Explain fibres used in fibre reinforced concrete (La & CO5)

Ans. STEEL FIBRE-

→ Aspect Ratio of 30 to 850
→ Diameter vary from 0.25 mm to 0.75mm
→ High structural Strength
→ Reduced crack width and Control the
→ Crack width tightly thus improving durability
→ Improve impact and Abrasion Resistance.

GLASS FIBER-

→ High tensile strength 1020 - 4080 N/mm²
→ Generally, fibers of length 25 mm are used
→ Improvement in impact Strength
→ Increased flexural strength, ductility and

resistance to thermal shock.

→ Used in form work, ducts and roofs, sewer lining etc.

SYNTHETIC FIBRE –

→ Man Made fiber from petrochemical and textile industries

→ Cheap, abundantly available

→ High chemical resistance

→ High Melting Point

→ Low Modulus of Elasticity.

NATURAL FIBER –

→ Obtained at low cost and low level of energy using lower manpower and Technology

→ They may undergo organic decay

→ Low Modulus of Elasticity, high impact Strength

→ Example : Jute, Coir, bamboo.

Vijaylaxmi.
(Prof. Vijaylaxmi)